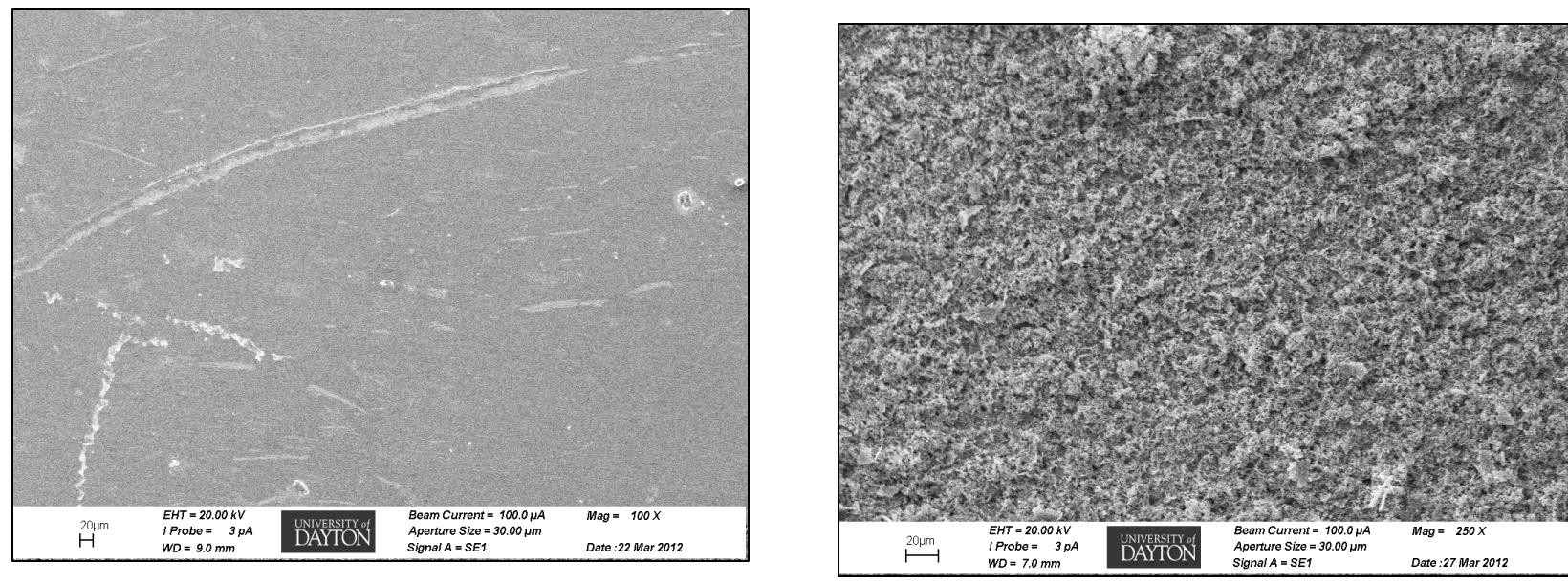


# Rates of Corrosion of Various Metals in a Modified B117 Chamber

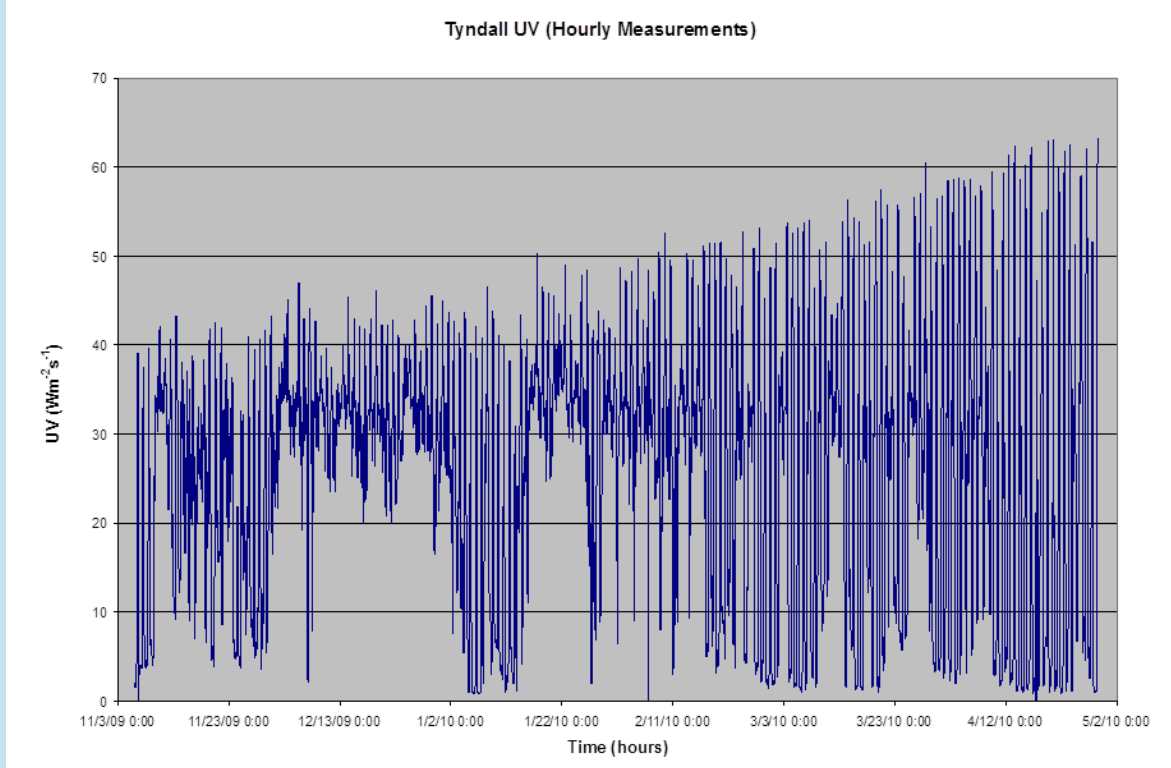
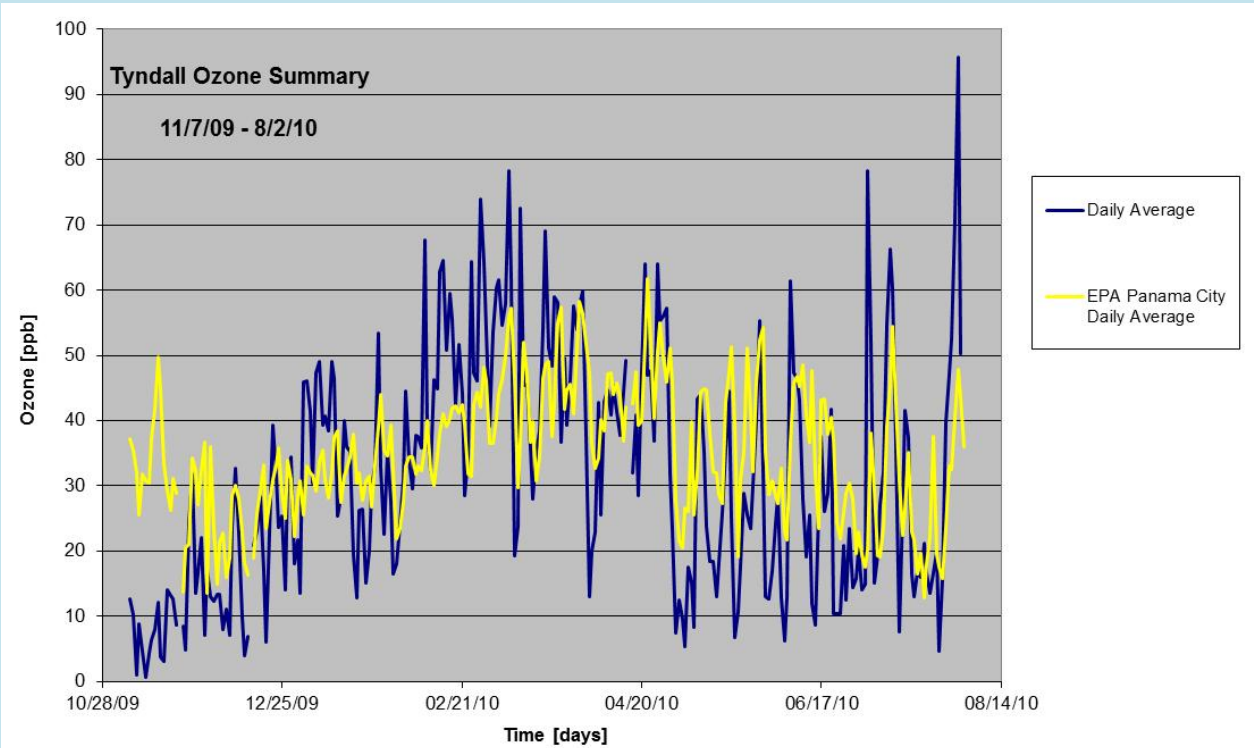
Name: Philip T. Wille

Advisors: Dr. Douglas C. Hansen, Dr. Yuhchae Yoon and Dr. Leanne Petry

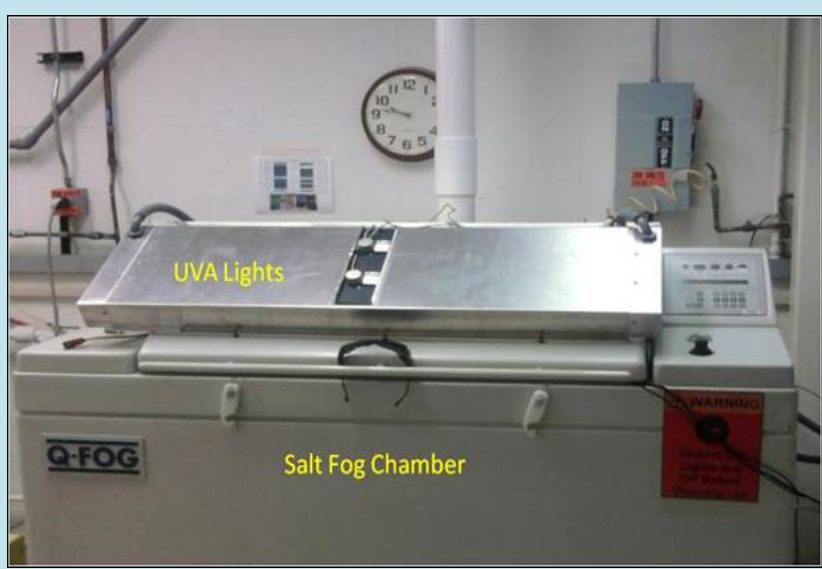


## Introduction

- ASTM Exposure Chamber test consists of 5% NaCl salt solution at temperature of 35±2 °C (95±3°F).
- Standard B117 exposure chamber test does not accurately simulate conditions out in field.

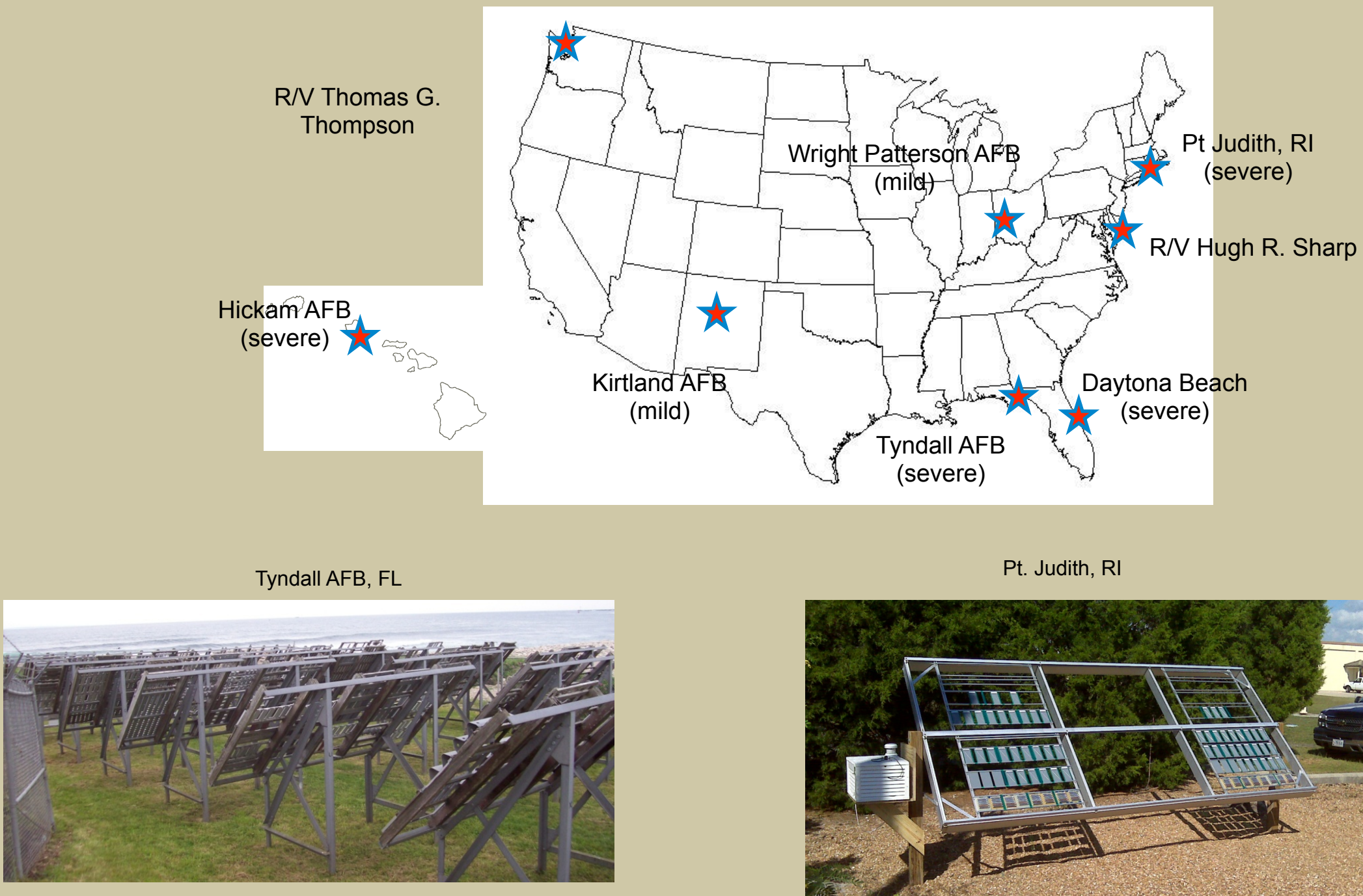


- **Modified Atmospheric CHamber (MACH-1.0)** is a B117 chamber with adjustable levels of UV and Ozone



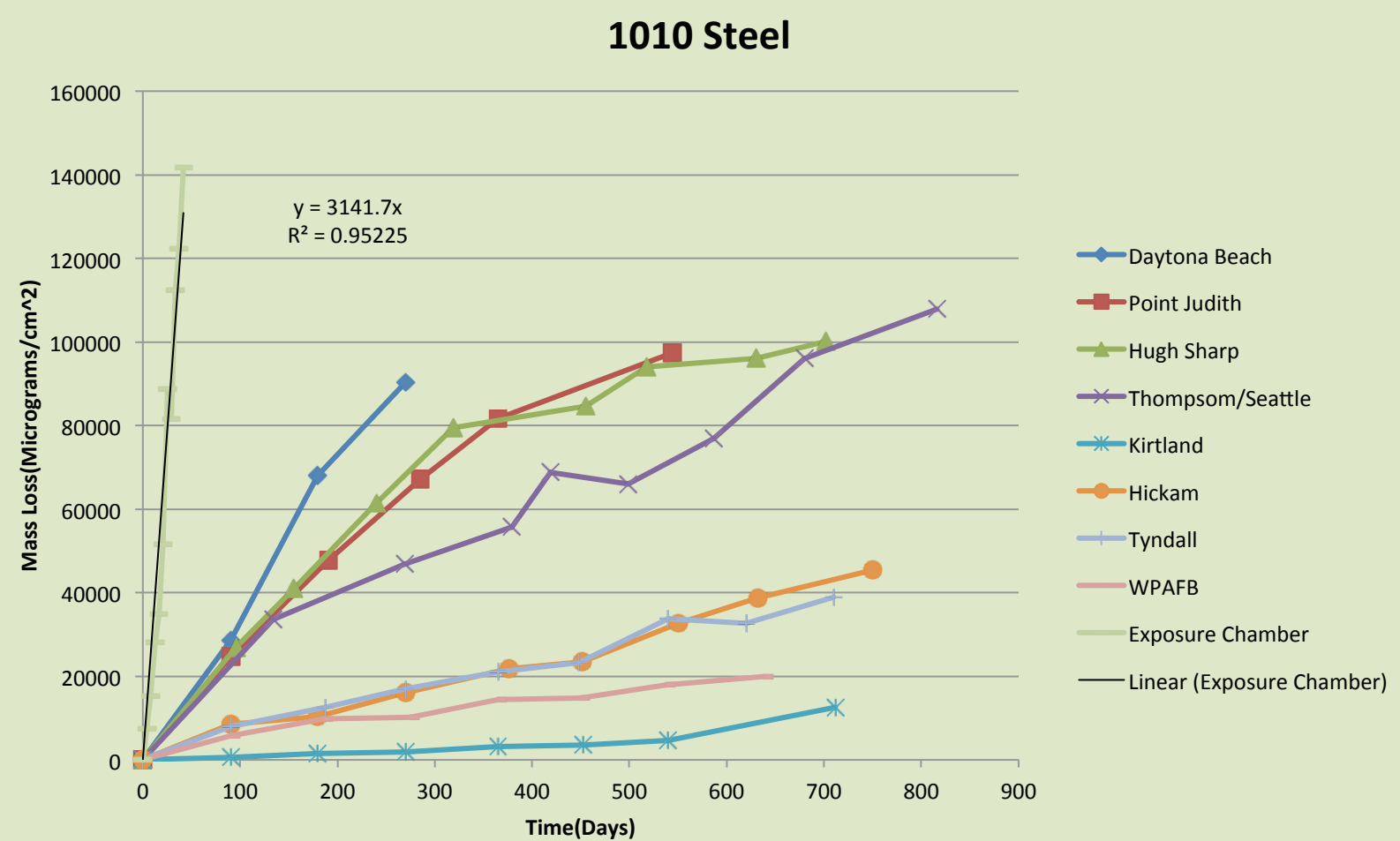
## Objectives

- Compare how differing amounts of UV and Ozone in the MACH-1.0 chamber affect the corrosion rate of various metals (1010 Steel, Copper, Al 7075, Al 6061, Al 7075).
- Correlate rates of corrosion in field to Mach 1.0 chamber.

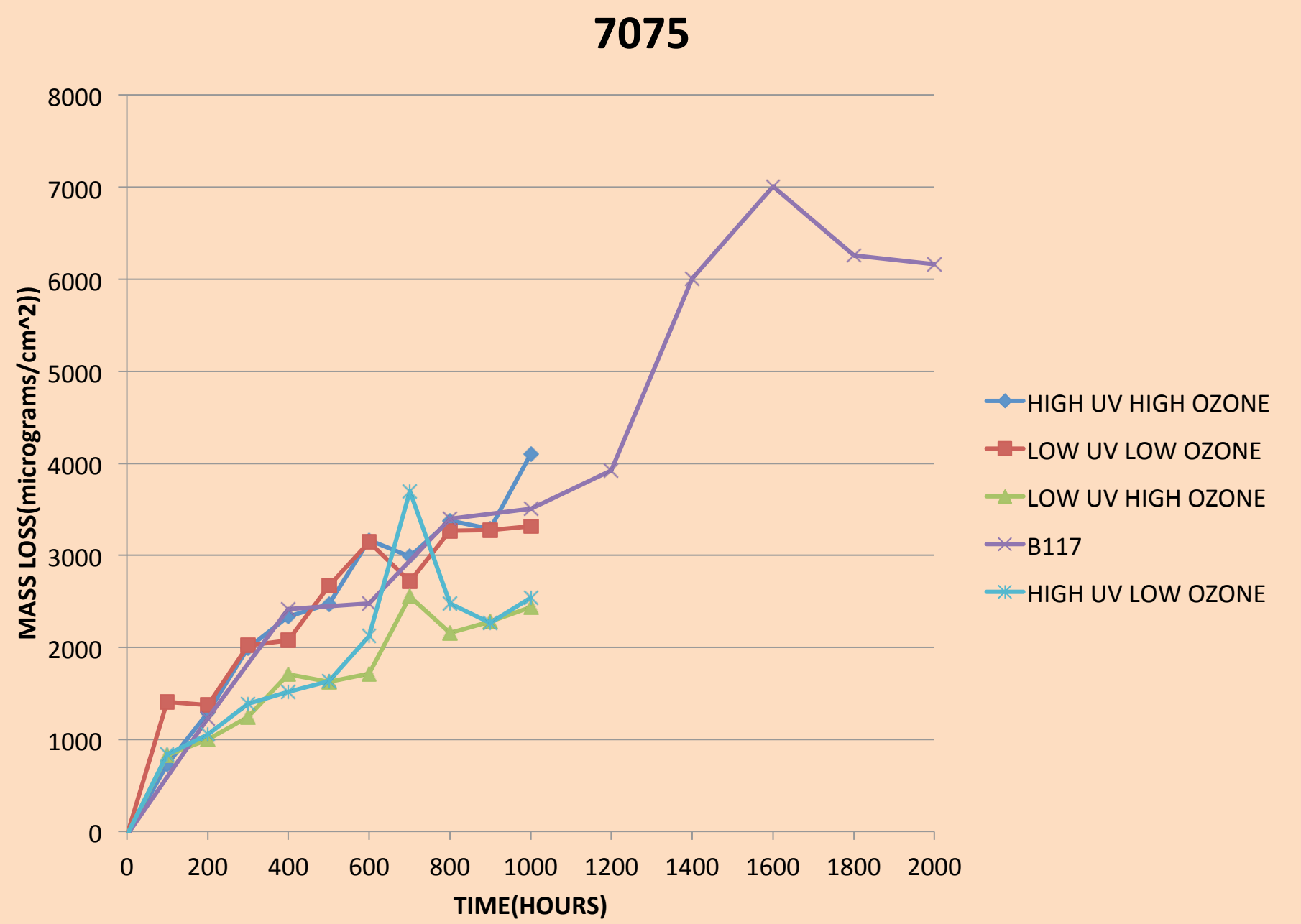
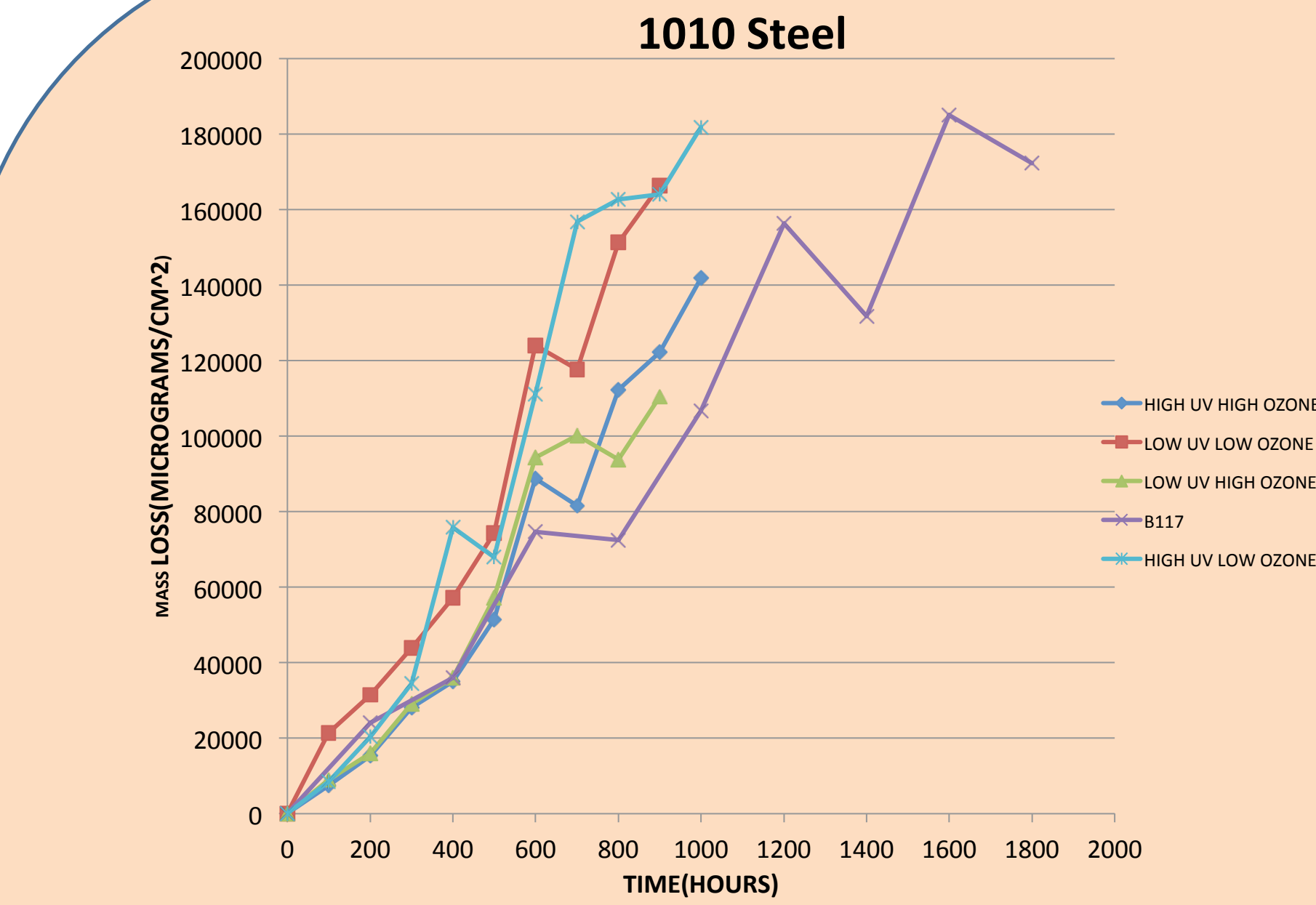


## Methodology

- UV and Ozone was adjusted using four different exposure levels: High UV High Ozone, Low UV Low Ozone, High UV Low Ozone, and Low UV High Ozone.
- High and low UV had a radiative flux of 0.96W/m² and 0.1 W/m², respectively; ozone was adjusted from 800ppb to 100ppb for high and low, respectively.
- Samples were then cleaned and massed using standard ASTM cleaning procedures.



## Results

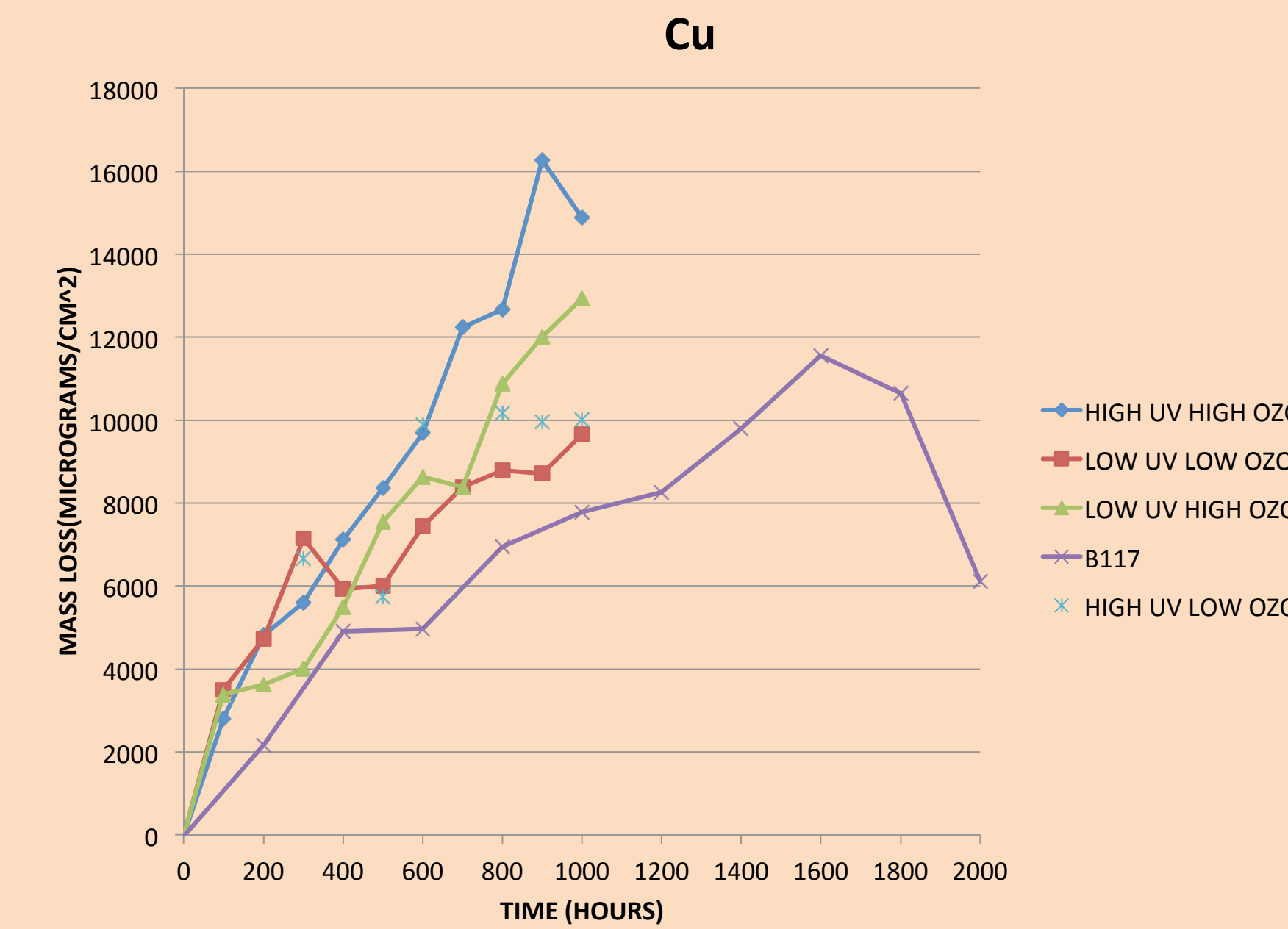
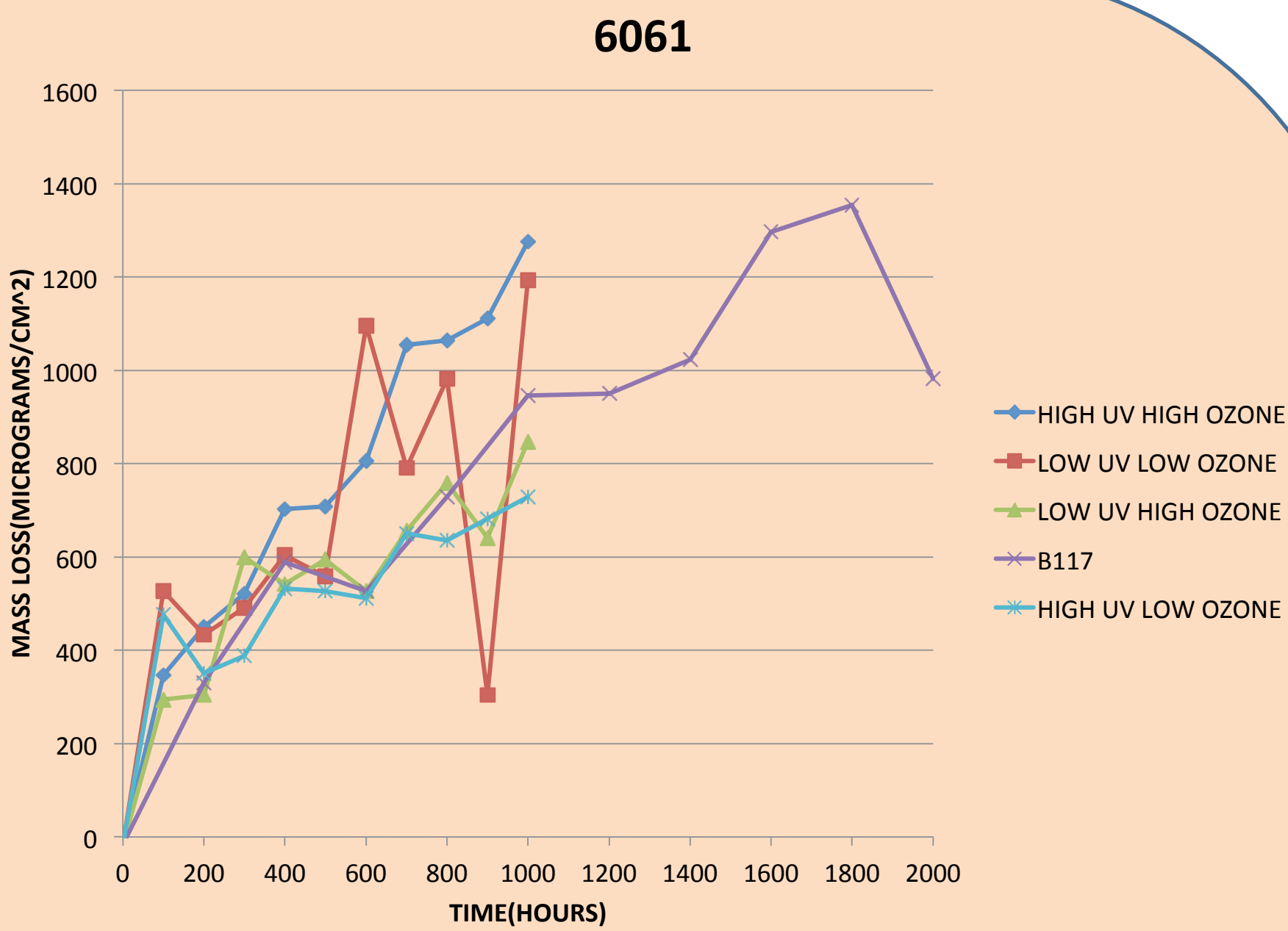
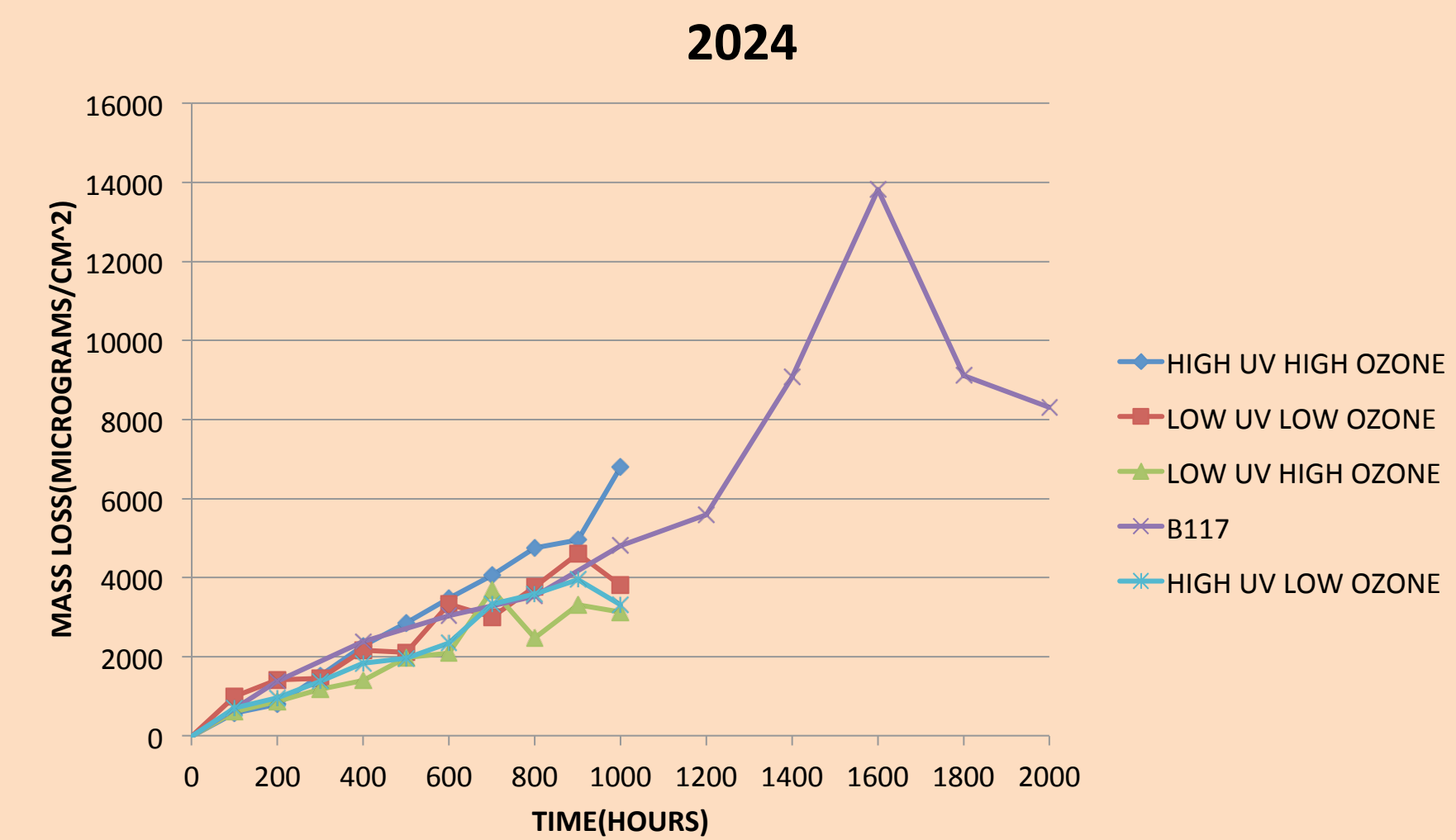


High UV High Ozone Acceleration Factors								
	Daytona Beach	Point Judith	Hugh Sharp	Thompson/Seattle	Kirtland	Hickam	Tyndall	WPAFB
7075 Al	18.5	34.4	36.0	42.0	13099.4	238.2	107.5	555.9
2024 Al	17.7	36.7	50.7	58.1	12479.5	393.2	394.2	1167.0
6061 Al	45.2	50.2	19.5	26.49	2738.8	193.7	193.5	288.5
Cu	16.7	18.0	23.0	32.4	55.1	30.4	35.8	27.7
Steel	9.2	13.8	15.6	20.6	362.4	51.4	51.8	80.4

Low UV Low Ozone Acceleration Factors								
	Daytona Beach	Point Judith	Hugh Sharp	Thompson/Seattle	Kirtland	Hickam	Tyndall	WPAFB
7075 Al	17.4	32.3	33.8	39.5	12325.6	224.1	101.1	523.1
2024 Al	13.7	28.4	39.2	45.0	9660.8	304.4	305.2	903.4
6061 Al	36.7	40.7	15.8	21.5	2221.9	157.2	157.0	234.0
Cu	11.4	12.3	15.7	22.1	37.6	20.7	24.4	18.9
Steel	12.5	18.8	21.3	28.1	494.6	70.1	70.7	109.7

High UV Low Ozone Acceleration Factors								
	Daytona Beach	Point Judith	Hugh Sharp	Thompson/Seattle	Kirtland	Hickam	Tyndall	WPAFB
7075 Al	13.8	25.6	26.8	31.3	9759.2	177.5	80.1	414.1
2024 Al	12.2	25.3	35.0	40.1	8607.4	271.2	271.9	804.9
6061 Al	28.5	31.7	12.3	16.72	1729.0	122.3	122.2	182.1
Cu	12.1	13.0	16.7	23.4	39.9	22.0	25.9	20.0
Steel	13.0	19.6	22.1	29.2	514.6	73.0	73.5	114.1

Low UV High Ozone Acceleration Factors								
	Daytona Beach	Point Judith	Hugh Sharp	Thompson/Seattle	Kirtland	Hickam	Tyndall	WPAFB
7075 Al	12.3	22.8	23.9	27.9	8692.7	158.1	71.3	368.9
2024 Al	10.8	22.5	31.0	35.6	7646.0	240.9	241.5	715.0
6061 Al	30.8	34.2	13.3	18.1	1868.3	132.2	132.0	196.8
Cu	13.5	14.6	18.6	26.2	44.6	24.6	28.9	22.4
Steel	8.8	13.2	14.9	19.7	346.8	49.2	49.5	76.9



## Conclusions

- Varying the levels of UV and Ozone does have an effect on the corrosion rate of bare metals.
- Steel – Exhibited the highest corrosion rates of all metals tested.
- Ozone levels seem to affect corrosion rate more than UV does.
- Cu/7075/2024/6061- Higher levels of UV and ozone give higher corrosion rates. This suggests that the combined UV and ozone may be disrupting the passive oxide layer of Cu, 7075, 2024, and 6061 alloys. The inability to form a passive oxide layer gives rise to higher rates of corrosion.
- Mass loss of Cu and Al alloys: Cu > 7075 ≈ 2024 > 6061
- Acceleration factors correspond to this conclusion. Higher UV levels give higher rates of corrosion

## References

- ASTM Standard G1-03 (2011), "Standard Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens," ASTM International, West Conshohocken, Pa, DOI: 10.1520/G0001-03R11, [www.astm.org](http://www.astm.org).
- ASTM Standard B117-11, "B117-11 Standard Practice for Operating Salt Spray (Fog) Apparatus," ASTM International, West Conshohocken, Pa, DOI: 10.1520/B0117-11, [www.astm.org](http://www.astm.org).
- Chen, Z. Y., D. Liang, G. Ma, G. S. Frankel, H. C. Allen, and R. G. Kelly. "Influence of UV Irradiation and Ozone on Atmospheric Corrosion of Bare Silver." *Corrosion Engineering, Science and Technology* 45.2 (2010): 169-80. Web. 11 Apr. 2013.